Claims

1. Lead substitute material for radiation protection purposes in the energy range of an X-ray tube having a voltage of from 60 to 140 kV, wherein for nominal overall lead equivalents of from 0.25 to 2.00 mm the lead substitute material comprises
from 12 to 22 wt.% of a silicone-based material,
from 1 to 75 wt.% Sn or Sn compounds,
from 0 to 73 wt.% W or W compounds,
from 0 to 80 wt.% Bi or Bi compounds.

2. Lead substitute material according to claim 1,
characterised in that
the lead substitute material comprises
from 12 to 22 wt.% of the silicone-based material,
from 1 to 39 wt.% Sn or Sn compounds,
from 0 to 60 wt.% W or W compounds and
from 0 to 60 wt.% Bi or Bi compounds.

3. Lead substitute material according to claim 2,
characterised in that
the lead substitute material comprises
from 12 to 22 wt.% of the silicone-based material,
from 0 to 39 wt.% Sn or Sn compounds,
from 16 to 60 wt.% W or W compounds and
from 16 to 60 wt.% Bi or Bi compounds.

4. Lead substitute material according to claim 1,
characterised in that
the lead substitute material comprises
from 12 to 22 wt.% of the silicone-based material,
from 40 to 60 wt.% Sn or Sn compounds,

from 7 to 15 wt.% W or W compounds and
from 7 to 15 wt.% Bi or Bi compounds.

5. Lead substitute material according to any one of claims 1 to 4,
characterised in that
the lead substitute material additionally comprises up to 40 wt.% of one or more of the following elements: Er, Ho, Dy, Tb, Gd, Eu, Sm and/or their compounds and/or CsI.

6. Lead substitute material according to claim 5,
characterised in that
the lead substitute material additionally comprises up to 20 wt.% of the elements and/or their compounds and/or CsI.

7. Lead substitute material according to claim 6,
characterised in that
the lead substitute material additionally comprises up to 8 wt.% of the elements and/or their compounds and/or CsI.

8. Lead substitute material according to any one of claims 1 to 7,
characterised in that
the lead substitute material additionally comprises up to 40 wt.% of one or more of the following elements: Ta, Hf, Lu, Yb, Tm, Th, U and/or their compounds.

9. Lead substitute material according to claim 8,
characterised in that

the lead substitute material additionally comprises up to 20 wt.% of the elements and/or their compounds.

10. Lead substitute material according to claim 9, **characterised in that** the lead substitute material additionally comprises up to 8 wt.% of the elements and/or their compounds.

11. Lead substitute material for radiation protection purposes in the energy range of an X-ray tube having a voltage of from 60 to 90 kV according to any one of claims 5 to 10, **characterised in that** for nominal overall lead equivalents of from 0.25 to 0.6 mm the lead substitute material comprises
from 12 to 22 wt.% of the silicone-based material,
from 49 to 65 wt.% Sn or Sn compounds,
from 0 to 20 wt.% W or W compounds,
from 0 to 20 wt.% Bi or Bi compounds and
from 5 to 35 wt.% of one or more of the elements Gd, Eu, Sm and/or their compounds and/or CsI.

12. Lead substitute material according to any one of claims 1 to 11, **characterised in that** the silicone-based material comprises silicone rubber.

13. Lead substitute material according to claim 12, **characterised in that** the silicone rubber comprises dimethyl silicone rubber, phenylmethyl silicone rubber, phenyl silicone rubber and polyvinyl silicone rubber.

14. Lead substitute material according to any one of claims 1 to 13, **characterised in that** it comprises fillers and processing aids.

15. Lead substitute material according to any one of claims 1 to 14, **characterised in that** it comprises a structure of protective layers of different compositions.

16. Lead substitute material according to claim 15, **characterised in that** it comprises a structure of at least two protective layers of different compositions which are separate or joined together, wherein the protective layer(s) more remote from the body comprise(s) predominantly the elements having a lower atomic number, or their compounds, and the protective layer(s) close to the body comprise(s) predominantly the elements having a higher atomic number, or their compounds.

17. Lead substitute material according to claim 15 or 16, **characterised in that** it comprises a structure of at least two protective layers of different compositions which are separate or joined together, wherein at least in one layer at least 50% of the total weight consists of only one element from the group Sn, W and Bi or their compounds.

18. Lead substitute material according to claim 16, **characterised in that**

it comprises a structure of at least two protective layers of different compositions which are separate or joined together, wherein the protective layer(s) more remote from the body comprise(s) predominantly the elements or their compounds having a higher X-ray fluorescent yield, and the protective layer(s) close to the body comprise(s) the elements or their compounds having a lower X-ray fluorescent yield.

19. Lead substitute material according to any one of claims 16 to 18,
characterised in that
a weakly radioactive layer is embedded between two non-radioactive protective layers which are separate from or joined to the radioactive layer.

20. Lead substitute material according to any one of claims 1 to 19,
characterised in that
the metals or metal compounds are granular and their particle sizes exhibit a 50th percentile according to the following formula

$$D_{50} = \frac{d \cdot p}{10} \text{mm}$$

wherein
D_{50} represents the 50th percentile of the particle size distribution,
d represents the layer thickness in mm and
p represents the proportion by weight of the particular material component in the total weight,

and the 90th percentile of the particle size distribution $D_{90} \leq 2 \cdot D_{50}$.

21. Radiation protection clothing of lead substitute material according to any one of claims 1 to 20.